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CP-odd observables in $B \rightarrow P \ell \ell$

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We consider the combined measurements of CP-averaged decay rates and direct CP asymmetries of $B^\pm \rightarrow K^\pm \ell^+ \ell^-$ and $B^\pm \rightarrow \pi^\pm \ell^+ \ell^-$ to probe (non-local) four-quark operator matrix element contributions to rare semileptonic B meson decays. We also explore how their effects could be in principle disentangled from possible local new physics effects. We construct a ratio of CP-odd decay rate differences which are exactly predicted within the standard model in the U-spin limit. Our results motivate binned measurements of the direct CP asymmetry in $B^\pm \rightarrow \pi^\pm \ell^+ \ell^-$ as well as dedicated theoretical estimates of U-spin breaking both in local form factors as well as in four-quark matrix elements.

For $B \rightarrow K \mu \mu$ we show that possible NP phase in C_9 Wilson coefficient can be tested by measuring the direct CP-asymmetry. We show that this asymmetry is enhanced around the peak of each $c\bar{c}$ -resonance, and in fact more pronounced in the close vicinity of J/ψ and $\psi(2S)$. Therefore, measuring ACP below and above the resonances' peak could be revelatory of the CP-violation that originates from beyond the Standard Model, or to be a significant constrain when building a realistic scenario of New Physics.

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